I. Project Title:: **Interagency Standardized Monitoring Program (ISMP) Assessment of Endangered Fish Reproduction in Relation to Flaming Gorge Operations in the Middle Green and Lower Yampa Rivers.**

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III. Project Summary: The goal of the recently approved Flaming Gorge flow and temperature recommendations (Muth et al., 2000) was to improve the status and prospects for recovery of endangered fish populations in the Green River. A major emphasis of those recommendations was to enhance the reproductive and recruitment success of endangered fishes in the middle Green River, in particular razorback sucker and Colorado pikeminnow. The primary means to achieve enhanced populations will be to pattern flows after a more natural hydrograph, the timing and duration of which will be based on anticipated annual hydrologic conditions and the biology of the fish. Because of vagaries in timing and runoff patterns within and among various hydrologic scenarios, and uncertainties in anticipated effects of flow and temperature recommendations on endangered fishes, Muth et al. (2000) suggested that real-time data be gathered to guide and fine tune operation of Flaming Gorge dam each year. Two existing studies that have provided data to guide operations of Flaming Gorge Dam in the past are "Basin-wide Monitoring Program for Razorback Sucker" (Project 22C) and "Interagency Standardized Monitoring Program (ISMP) Assessment of Colorado Pikeminnow Reproduction and Larval Abundance in the Lower Yampa River, Colorado" (Project 22f). This proposal, which is an extension of portions of those existing studies, is intended to provide some of the necessary real-time data.

Larvae of razorback sucker *Xyrauchen texanus* and Colorado pikeminnow *Ptychocheilus lucius* were captured in the Green River basin in spring and summer 2005. Razorback sucker sampling was conducted with light traps primarily in the Green River between Jensen and Ouray and Colorado pikeminnow sampling was with drift nets in the lower Yampa River. Sampling was designed to provide a measure of timing of reproduction and a measure of annual reproductive success of each species. Diel variation in abundance of Colorado pikeminnow larvae in the drift was also assessed. This data will be used to assess effects of flow and temperature regimes on reproduction by razorback suckers and Colorado pikeminnow and to correlate abundance of larvae to abundance of juveniles in autumn.

IV. Study Schedule: It is anticipated that this study will continue and will be a component of studies designed to evaluate operations of Flaming Gorge Reservoir.

V. Relationship to RIPRAP: Reproduction and recruitment of early life stages are critical components of the life history of endangered razorback sucker and Colorado pikeminnow. Understanding trends in reproductive success may help define status of razorback sucker and Colorado pikeminnow in specific river reaches in the Colorado River Basin and should play a role in determining when recovery has been achieved.

Relationship to specific RIPRAP items:

<u>Green River Action Plan: Mainstem</u>

I.	Provide and protect instream flows--habitat management.
I.A.	Green River above Duchesne River.
I.A.1.	Initially identify year-round flows needed for recovery while providing experimental flows.
I.A.2.a.	Summer/fall flow recommendations.
I.A.3.	Deliver identified flows.
I.A.3.a.	Operate Flaming Gorge pursuant to the Biological Opinion to provide summer and fall flows.
I.A.3.d.	Operate Flaming Gorge Dam to provide winter and spring flows and revised summer/fall flows, if necessary.
I.B.	Green River below the Duchesne River.
I.B.1.	Initially identify year-round flows needed for recovery while providing experimental flows.
I.B.2.	State acceptance of initial flow recommendations.
I.B.2.a.	Review scientific basis.
II.	Restore habitat--habitat development and maintenance.
II.A.	Restore and manage flooded bottomland habitat.
II.A.1.	Conduct site restoration.
II.A.1.a.	Old Charlie Wash.
II.A.1.a.(3)	Monitor and evaluate success.

II.C.	Enhance water temperatures to benefit endangered fishes.
II.C.1.	Identify options to release warmer water from Flaming Gorge Reservoir to restore native fish habitat in the Green River.
V.	Monitor populations and habitat and conduct research to support recovery actions--research, monitoring, and data management.
V.A.	Conduct research to acquire life history information and enhance scientific techniques required to complete recovery actions.

Green River Action Plan: Yampa and Little Snake Rivers

I.	Provide and protect instream flows--habitat management.
I.D.	Yampa River below Little Snake River.
I.D.1.	Initially identify year-round flows needed for recovery.
I.D.2.	Evaluate need for instream flow water rights.
I.D.2.a.	Review scientific basis.

Green River Action Plan: Yampa and Little Snake Rivers

V.A.1.	Conduct standardized monitoring.
V.B.2.	Conduct appropriate studies to provide needed life history information.

VI. Accomplishment of FY 2004 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Project Objectives

1). To determine timing and duration of spawning by razorback suckers and presence and abundance of larvae in the system as measured by capture of larvae in light traps.

2). To determine timing and duration of spawning by Colorado pikeminnow and presence and abundance of larvae in the system as measured by capture of larvae downstream of spawning areas in the lower Yampa River.

Task Description (FY 2005)

I). Collect light trap samples for razorback suckers. The CRFP office in Vernal will be responsible for this task.

II). Collect drift net samples for Colorado pikeminnow. The Larval Fish Laboratory will be responsible for this task.

III). Identify light trap and drift net samples. Preliminary identifications will be conducted by the responsible sampling entity, with assistance from the LFL, as samples are collected to provide real-time data. Final specimen identification and curation will be conducted by the LFL.

IV). Summarize specimen data collection in an annual report.

Accomplishments by Task.

I). Collect light trap samples for razorback suckers. Light trap samples were collected during May and June 2005 by the Vernal CRFP.

II). Collect drift net samples for Colorado pikeminnow. Drift net samples were collected daily from 23 July until 14 August 2005 by the Larval Fish Laboratory. A total of 207 samples were collected during this time period, which includes some diel net sets.

III). Identify light trap and drift net samples. Preliminary identification completed, verification ongoing.

Middle Green River light trap samples. Samples sent to the Larval Fish Laboratory have been identified and will be verified by early 2006.

Lower Yampa River drift net sampling. Samples were collected in the Yampa River about 0.2 to 0.8 km upstream from the Green River, the same site that samples were collected from 1990 to 1996 (Bestgen et al. 1998) and in 1998 to 2003. Samples have been identified and verification will be completed in early 2006.

2004 light trap sampling data. Only preliminary data were available from 2004 light trap samples at the time of the November 2004 report deadline so we present that data now. A total of 1,092 razorback sucker larvae were captured in light traps in the Green River in 2004 (Figure 1). This is a dramatic increase in abundance over recent years. For example, a total of 47 razorback sucker larvae were captured in light traps in 2003 and an additional 4 were captured in seine hauls (including several specimens classified as razorback sucker?). Light traps sample captures of razorback suckers in other recent years include 94 in 2002, 92 in 2001, and 82 in 2000.

In 2004, a release of marked razorback sucker larvae (N = 69,688) was made associated with pilot sampling to examine entrainment of larvae and beads into floodplain wetlands. Thus, some 2004 larvae captured were likely released individuals. However, as many as 326 larvae were captured on or before 25 May 2004 (Figure 2). Additionally, drift sampling for entrainment studies also captured 232 wild razorback sucker larvae on the release day, indicating large numbers of wild larvae in the system. An additional 463 larvae were captured in light trap samples from 26 to 28 May 2004. Peaks in abundance of razorback sucker larvae were noted on 25 May, 27-28 May, and 2-4 June. Mean length of larvae remained relatively similar across the sampling season at about 11 to 12-mm TL (Figure 3).

2005 light trap sampling data. We added additional staff in 2005 to facilitate identification of samples collected in this study, so unlike in previous years, preliminary identifications of samples are available at this time. A total of 475 razorback sucker larvae were captured in 2005 compared with 1,092 razorback sucker larvae captured in light traps in the Green River in 2004 (Figure 4). The smaller number captured in 2005 may be due to presence of higher and more prolonged flows present in the Green River Basin, in part due to floodplain wetland entrainment studies. The 2005 sampling results yielded many more fish than the 51 razorback sucker captured in 2003.

Similar to 2004, in 2005 several releases of marked razorback sucker larvae were made associated with sampling to examine entrainment of larvae and beads into floodplain wetlands. Thus, some 2005 larvae captured were likely released individuals. Peaks in abundance of razorback sucker larvae were noted on 25 May, 1-2 June, 7-8 June, 14 to 16 June, and 21 to 22 June. Mean length of larvae remained relatively similar across the sampling season at about 11-mm TL, although not all larvae have been measured yet (Figure 5).

It is unknown how many of the razorback sucker larvae captured in 2004 and 2005 were ones that were marked and released associated with floodplain entrainment studies. All larvae should be examined for marks so that capture rates of wild larvae can be estimated and compared with historical sampling. A tentative conclusion from this sampling is that hatchery-produced razorback suckers stocked into the Green River must be spawning. This is based on a population of wild adults that should be very low or non-existent by this time (Bestgen et al. 2002).

2004 drift net sampling data. Only preliminary data were available from 2004 light trap samples at the time of the November 2004 report deadline so we present that data now. A total of 322 Colorado pikeminnow larvae were captured in 2004 (Figure 6). This is an increase over 2003, when only 87 Colorado pikeminnow larvae were captured in drift nets in 2003, which represented the lowest total since 1990, with the exception of 1995. A single relatively large peak of larvae was captured 22 to 23 July 2004; captures were low at other times (Figure 5). Mean TL of Colorado pikeminnow larvae captured was constant over the summer period at about 9 mm (Figure 7).

2005 drift net sampling data. We added additional staff in 2005 to facilitate identification of samples collected in this study, so unlike in previous years, preliminary identifications of drift net samples are available at this time. In 2005, we captured 318 Colorado pikeminnow larvae. Two large peaks were apparent in 2005, one from 14 to 16 July and another on 25 July (Figure 8). Mean TL of Colorado pikeminnow larvae captured was not available yet.

Temperature monitoring. Temperature differences between the Green and Yampa rivers in Echo Park are potentially important because of potential for cold shock of Colorado pikeminnow larvae drifting from the Yampa into the normally colder Green River. Warmer water temperatures in the Green River also increase the likelihood of spawning by rare native fishes upstream of the Yampa River. Temperature data gathered in the Green and Yampa rivers in Echo Park were compared to determine if temperature differences fall within recommended constraints that the Green be no more than about 5ºC colder than the Yampa River (Muth et al. 2000). In 2000, water temperatures in the Green River were relatively cool and exceeded 20ºC for only a couple of days. Average water temperature in the Green River from 1 June to 30 September was 17.0ºC compared to 19.7ºC in the Yampa River for the same period (Table 1). In 2001 to 2003, average water temperatures in the Green River were warmer and averaged about 19ºC in each year. Average summer water temperatures in the Yampa River from 2001 to 2003 were about 1.5 to 2.1 C warmer than the Green River during the same period. In seven instances (twice in 2000, once in 2001 and four times in 2002, none in 2003) water temperatures exceeded the recommended maximum summer difference of 5ºC. None of those days were within the period when Colorado pikeminnow were drifting downstream from the Yampa River. In 2002, summer water temperatures in the Green River upstream of the Yampa River were likely the highest observed since Flaming Gorge Reservoir filled. In 2003 water temperatures in the Green River in Lodore Canyon were also warm and exceeded 20C on most days from early July through early September. Preliminary data through July 2004, showed that water temperatures exceeded 20C for only about a 2-week period beginning in early July. We do not yet have 2005 data available so temperature differences between the Yampa and Green rivers at their confluence in Echo Park is not known.

VII. Recommendations: Continue to sample early life stages of razorback sucker and Colorado pikeminnow annually at these sites. This information is critical to establishment of long-term data that can guide informed management decisions regarding population viability and recovery. Data were also used to monitor effects of Flaming Gorge flows and water temperatures in relation to endangered fish reproduction in spring and summer. This information can also be used to make real-time recommendations for flow and temperature regimes for Flaming Gorge Dam during the critical time of reproduction for endangered Colorado pikeminnow. The Recovery Program should increase funding for this project to cover costs for additional sample processing costs incurred for the Green River samples. Sampling may also need to be expanded to assess reproduction by razorback suckers in the Yampa River.

VIII. Project Status: On track and ongoing. This project was approved for funding in 2006 and perhaps beyond. That information, combined with more sophisticated water

temperature data acquisition, should provide some tools for making flow and temperature recommendations to guide operation of Flaming Gorge Reservoir.

IX. FY 2005 Budget Status

A. Funds Provided: $99,200
B. Funds Expended: $96,000
C. Difference: 3,200 remaining funds for sample analysis
D. Percent of the FY 2005 work completed, and projected costs to complete: About 95% complete.
E. Recovery Program funds spent for publication charges: None.

X. Status of Data Submission (Where applicable): Data will be submitted when identification and analysis is complete.

XI. Signed: Kevin R. Bestgen 11 Nov. 2005
Principal Investigator Date
(Just put name and date here, since you will be submitting the report electronically)

APPENDIX: [More comprehensive/final project reports (NOT to be used in place of a complete annual report.). If distributed previously, simply reference the document or report.]

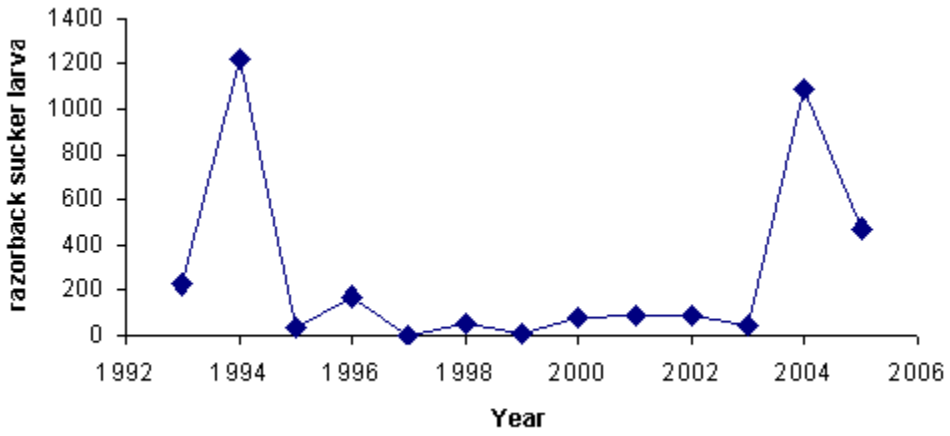

Figure 1. Number of razorback sucker larvae captured from 1993 to 2005 in the middle Green River, Utah, in light traps.

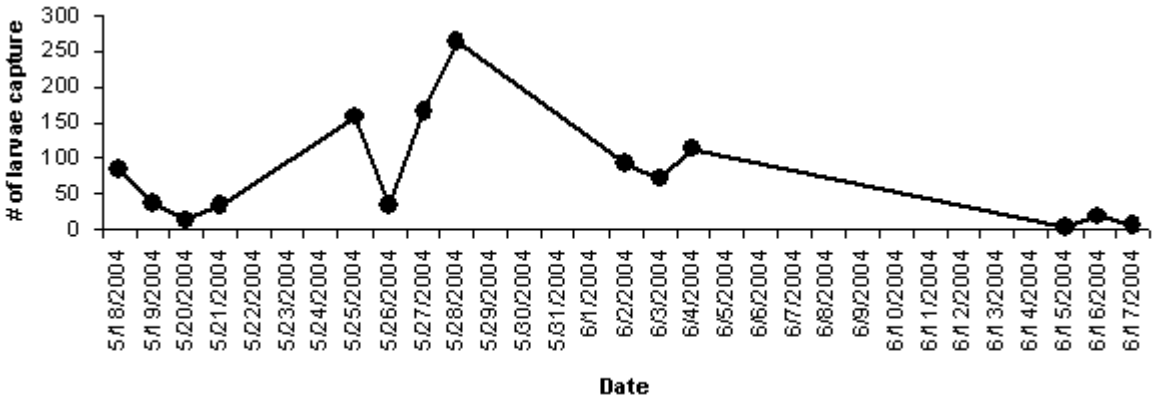

Figure 2. Number of razorback sucker larvae captured in light trap sampling in the Green River, Utah, spring and summer 2004. May include substantial numbers of hatchery-reared larvae released for floodplain entrainment studies.

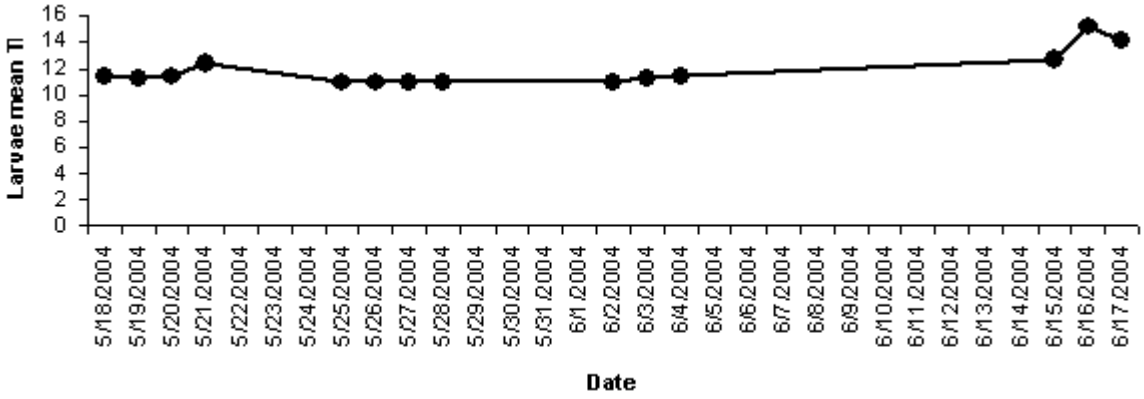

Figure 3. Mean TL of razorback sucker larvae captured in light trap sampling in the Green River, Utah, spring and summer 2004.

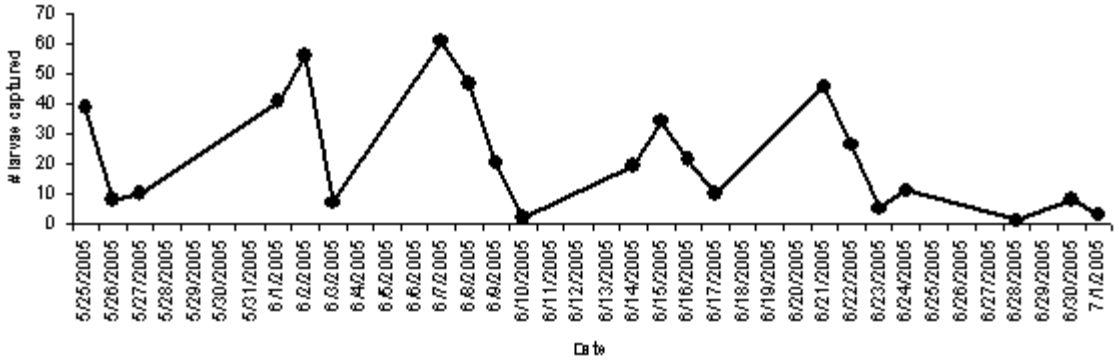

Figure 4. Number of razorback sucker larvae captured in light trap sampling in the Green River, Utah, spring and summer 2005. May include substantial numbers of hatchery-reared larvae released for floodplain entrainment studies.

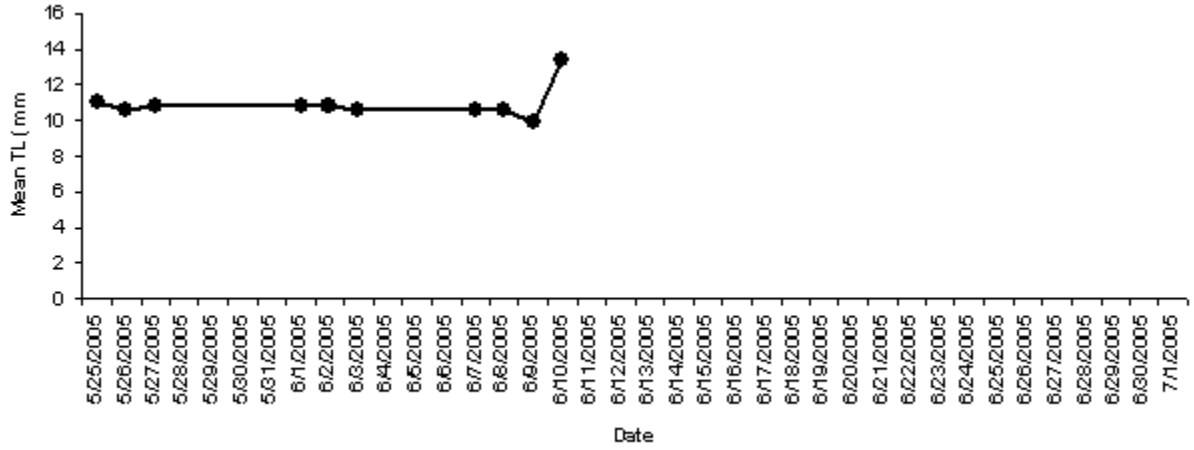

Figure 5. Mean TL of razorback sucker larvae captured in light trap sampling in the Green River, Utah, spring and summer 2005.

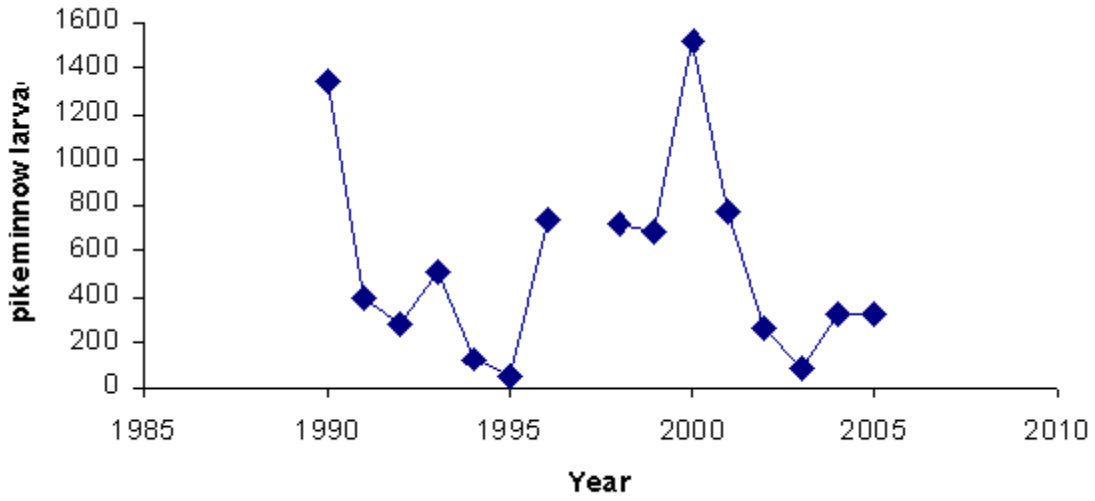

Figure 6. Number of Colorado pikeminnow larvae captured from 1990 to 2003 (no sampling in 1997) in the lower Yampa River, Echo Park, Colorado, in drift nets set during all diel time periods.

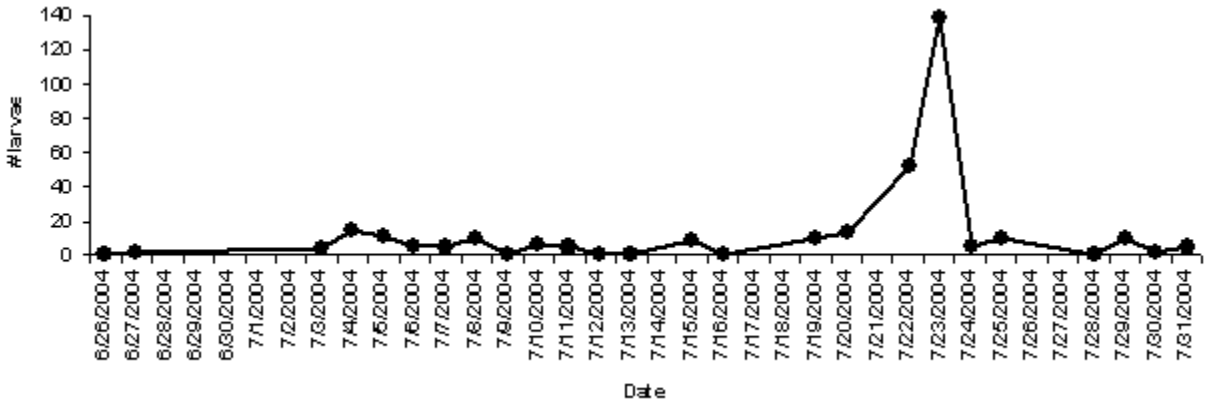

Figure 7. Number of Colorado pikeminnow larvae captured in drift net samples in the Yampa River, Colorado, summer 2004.

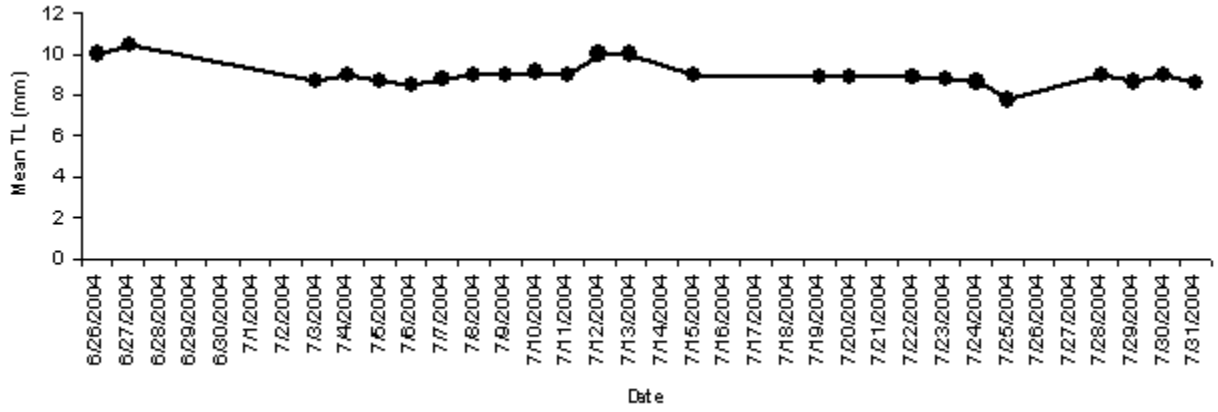

Figure 8. Mean TL of Colorado pikeminnow larvae captured in drift net samples in the Yampa River, Colorado, in summer 2005.

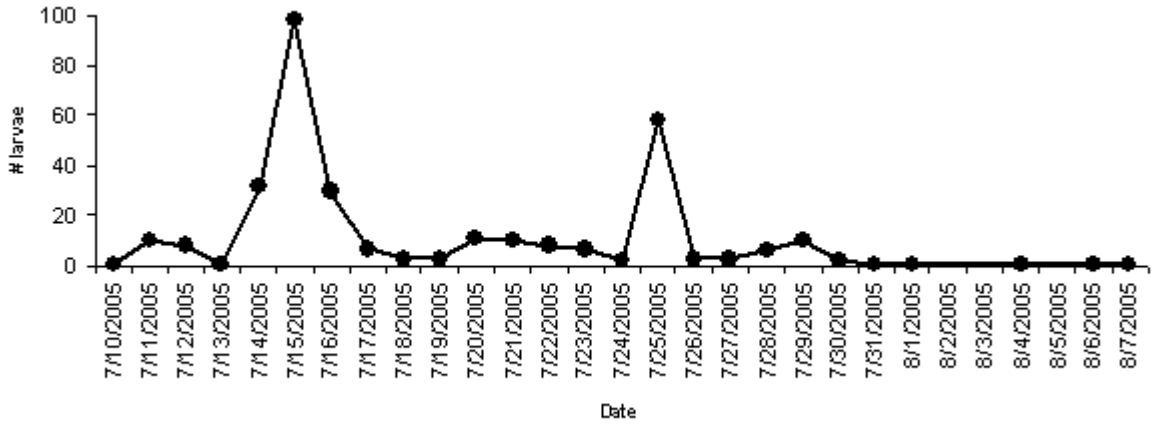

Figure 9. Number of Colorado pikeminnow larvae captured in drift net samples in the Yampa River, Colorado, summer 2005.

Table 1. Average daily summer (1 June to 30 September) water temperature (maximum) of the Green and Yampa rivers, Echo Park, Dinosaur National Park, Colorado, 2000 to 2004. Number of days where temperature of the Green River was 5ºC or more cooler than the Yampa River is also shown; none of those days were in the period when Colorado pikeminnow larvae were drifting from the Yampa River.

	Mean summer water temp C (maximum)		Number of days difference
Year	Green River	Yampa River	exceeded 5ºC
2000	17.0 (20.7)	19.7 (24.1)	2
2001	19.0 (23.4)	20.5 (25.6)	1
2002	18.5 (24.5)	20.4 (25.3)	4
2003	18.7 (23.2)	20.1 (25.9)	0
2004*	19.3 (23.6)	18.1 (21.6)	0